

Tri-Dimensional Engineering, Inc.
ENGINEERING • PLANNING • SURVEYING

Stormwater Management Plan (SWMP)

La Brea West Homes

Pala Street

Ramona, California 92065

(Clearing and grading for 14 detached residential homes and hardscape)

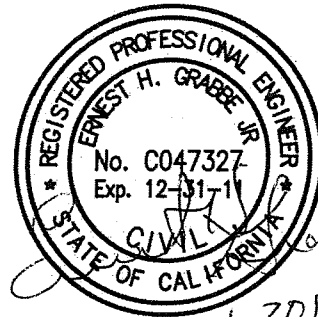
(Disturbed area = 1.31 acre)

TM-5535

Environmental Log No. 07-09-005

Prepared for:

LB Village Investments, LLC
and
County of San Diego



Prepared by:

Tri-Dimensional Engineering, Inc.
August 1, 2009



County of San Diego

STORMWATER INTAKE FORM FOR DEVELOPMENT PROJECTS

This form must be completed in its entirety and accompany applications for any of the discretionary or ministerial permits and approvals referenced in Sections 67.803(c)(1) and 67.803(c)(2) of the County of San Diego Watershed Protection, Stormwater Management and Discharge Control Ordinance (WPO).

STEP 1: IDENTIFY RELEVANT PROJECT INFORMATION

Applicant Name: LB Village Investments, LLC - Steve Powell (Member)		Contact Information: P.O. Box 823, Ramona, CA 92065 (760) 789-5493
Project Address: 0 Pala Street, Ramona CA 92065	APN(s): 282-130-13	Permit Application #:

STEP 2: DETERMINE PRIORITY DEVELOPMENT PROJECT STATUS

WPO Section 67.802(w) defines the criteria for determining whether your project is considered a Priority Development Project (PDP). If you answer "Yes" to any of the questions below, your project is a PDP subject to review and approval of a Major Stormwater Management Plan (SWMP). If you answer "No" to all of the questions below, your project is subject to review and approval of a Minor SWMP.

1. Residential subdivision of 10 or more dwelling units (Single-family, Multi-family, Condo, or Apartment Complex) ☒ No
2. Commercial development that includes development of land area greater than one (1) acre Yes ☒
3. Industrial development greater than one (1) acre Yes ☒
4. Automotive repair shop Yes ☒
5. Restaurant or restaurant facilities with an area of development of 5,000 square feet or greater Yes ☒
6. On a steep hillside (>25% natural slope) AND proposes 5,000 square feet of impervious surface or more, or includes grading of any natural slope >25% ⁽¹⁾ Yes ☒
7. Located within 200 feet of an Environmentally Sensitive Area AND creates 2,500 square feet or more of impervious surface or increases the area of imperviousness of a site to more than 10% of its naturally occurring condition ⁽¹⁾ ⁽²⁾ Yes ☒
8. A parking lot that is 5,000 square feet or greater OR proposes at least 15 new parking stalls Yes ☒
9. Streets or roads that create a new paved surface that is 5,000 square feet or greater Yes ☒
10. Retail gasoline outlet Yes ☒

⁽¹⁾ In lieu of a Major SWMP, Ministerial Permit Applications for residential dwellings/additions on an existing legal lot answering "Yes" may be able to utilize the Minor Stormwater Management Plan upon approval of a county official. Please note that upon further analysis, staff may determine that a Major SWMP will be required.

⁽²⁾ A County technician will assist you in determining whether your project is located within 200 feet of an Environmentally Sensitive Area.



If you answered "Yes" to any of the questions, please complete a Major SWMP for your project.

Instructions and an example of the form can be downloaded from http://www.co.san-diego.ca.us/dpw/watersheds/land_dev/susmp.html

If you answered "NO" to all of the questions above, please complete a Minor SWMP for your project.

Instructions and an example of the form can be downloaded from <http://www.sdcounty.ca.gov/dplu/docs/LUEG-SW.pdf>

STEP 3: SIGN AND DATE THE CERTIFICATION

APPLICANT CERTIFICATION: I have read and understand that the County of San Diego has adopted minimum requirements for managing urban runoff, including stormwater, from construction and land development activities. I certify that this intake form has been completed to the best of my ability and accurately reflects the project being proposed. I also understand that non-compliance with the County's WPO and Grading Ordinance may result in enforcement by the County, including fines, cease and desist orders, or other actions.

Applicant:

Date:

8/1/09





Storm Water Management Plan For Priority Projects (Major SWMP)

The Major Stormwater Management Plan (Major SWMP) must be completed in its entirety and accompany applications to the County for a permit or approval associated with certain types of development projects. To determine whether your project is required to submit a Major or Minor SWMP, please reference the County's Stormwater Intake Form for Development Projects.

Project Name:	La Brea West Homes
Permit Number (Land Development Projects):	TM - 5535
Work Authorization Number (CIP only):	
Applicant:	LB Village Investments, LLC
Applicant's Address:	0 Pala Street, Ramona, CA 92065
Plan Prepare By (<i>Leave blank if same as applicant</i>):	Ernest H. Grabbe, Jr., Tri-Dimensional Engineering, Inc.
Date:	March 12, 2007
Revision Date (If applicable):	May 1, 2009

The County of San Diego Watershed Protection, Storm Water Management, and Discharge Control Ordinance (WPO) (Ordinance No. 9926) requires all applications for a permit or approval associated with a Land Disturbance Activity to be accompanied by a Storm Water Management Plan (SWMP) (section 67.806.b). The purpose of the SWMP is to describe how the project will minimize the short and long-term impacts on receiving water quality. Projects that meet the criteria for a priority development project are required to prepare a Major SWMP.

Since the SWMP is a living document, revisions may be necessary during various stages of approval by the County. Please provide the approval information requested below.

Project Stages	Does the SWMP need revisions?		If YES, Provide Revision Date
	YES	NO	
Initial Submittal			March 12, 2007
1st Revision			December 18, 2008
2nd Revision			May 1, 2009
3rd Revision			August 1, 2009

Instructions for a Major SWMP can be downloaded at
<http://www.sdcountry.ca.gov/dpw/watersheds/susmp/susmp.html>

Completion of the following checklists and attachments will fulfill the requirements of a Major SWMP for the project listed above.

PROJECT DESCRIPTION

Please provide a brief description of the project in the following box. Please include:

- Project Location
- Project Description
- Physical Features (Topography)
- Surrounding Land Use
- Proposed Project Land Use
- Location of dry weather flows (year-round flows in streams, or creeks) within project limits, if applicable.

The project site is located between La Brea and Robertson Streets, fronting Pala Street in the unincorporated City of Ramona. The proposed project consists of 14 detached unit condominiums on a 1.83 acre site. The site features a high point in the middle western portion that slopes away in all directions. A majority of runoff from this high point follows two slight depressions that conclude at a low point in the northeastern corner of the property before entering a culvert under the undeveloped Robertson Street.

The site is zoned Commercial/ Residential as is the remainder of the block it is located within. To the southeast, on the other side of La Brea Street is zoned Commercial and has been developed into a strip mall including a K-mart. To the southwest, on the other side of Pala Street and to the northwest on the other side of Robertson Street is zoned Residential. The proposed project is to be entirely residential.

PRIORITY DEVELOPMENT PROJECT DETERMINATION

Please check the box that best describes the project. Does the project meet one of the following criteria?

Table 1

PRIORITY DEVELOPMENT PROJECT	YES	NO
Redevelopment that creates or adds at least 5,000 net square feet of additional impervious surface area <u>and</u> falls under one of the criteria listed below.		<input checked="" type="checkbox"/>
Residential development of more than 10 units.	<input checked="" type="checkbox"/>	
Commercial developments with a land area for development of greater than 1 acre.		<input checked="" type="checkbox"/>
Heavy industrial development with a land area for development of greater than 1 acre.		<input checked="" type="checkbox"/>
Automotive repair shop(s).		<input checked="" type="checkbox"/>
Restaurants, where the land area for development is greater than 5,000 square feet.		<input checked="" type="checkbox"/>
Hillside development, in an area with known erosive soil conditions, where there will be grading on any natural slope that is twenty-five percent or greater, if the development creates 5,000 square feet or more of impervious surface.		<input checked="" type="checkbox"/>
Environmentally Sensitive Areas (ESA): All development located within or directly adjacent to or discharging directly to an ESA (where discharges from the development or redevelopment will enter receiving waters within the ESA), which either creates 2,500 square feet of impervious surface on a proposed project site or increases the area of imperviousness of a proposed project site to 10% or more of its naturally occurring condition. "Directly adjacent" means situated within 200 feet of the ESA. "Discharging directly to" means outflow from a drainage conveyance system that is composed entirely of flows from the subject development or redevelopment site, and not commingled with flows from adjacent lands.		<input checked="" type="checkbox"/>
Parking Lots 5,000 square feet or more or with 15 parking spaces or more and potentially exposed to urban runoff.		<input checked="" type="checkbox"/>
Streets, roads, highways, and freeways which would create a new paved surface that is 5,000 square feet or greater.		<input checked="" type="checkbox"/>
Retail Gasoline Outlets (RGO) that meet the following criteria: (a) 5,000 square feet or more or (b) a projected Average Daily Traffic (ADT) of 100 or more vehicles per day.		<input checked="" type="checkbox"/>

Limited Exclusion: Trenching and resurfacing work associated with utility projects are not considered Priority Development Projects. Parking lots, buildings and other structures associated with utility projects are subject to the WPO requirements if one or more of the criteria above are met.

If you answered **NO** to all the questions, then **STOP**. Please complete a Minor SWMP for your project.

If you answered **YES** to any of the questions, please continue.

HYDROMODIFICATION DETERMINATION

The following questions provide a guide to collecting information relevant to hydromodification management issues.

Table 2

	QUESTIONS	YES	NO	Information
1.	Will the proposed project disturb 50 or more acres of land? (Including all phases of development)		<input checked="" type="checkbox"/>	If YES, continue to 2. If NO, go to 6.
2.	Would the project site discharge directly into channels that are concrete-lined or significantly hardened such as with rip-rap, sackcrete, etc, downstream to their outfall into bays or the ocean?			If NO, continue to 3. If YES, go to 6.
3.	Would the project site discharge directly into underground storm drains discharging directly to bays or the ocean?			If NO, continue to 4. If YES, go to 6.
4.	Would the project site discharge directly to a channel (lined or un-lined) and the combined impervious surfaces downstream from the project site to discharge at the ocean or bay are 70% or greater?			If NO, continue to 5. If YES, go to 6.
5.	Project is required to manage hydromodification impacts.			Hydromodification Management Required as described in Section 67.812 b(4) of the WPO.
6.	Project is not required to manage hydromodification impacts.			Hydromodification Exempt. Keep on file.

An exemption is potentially available for projects that are required (No. 5. in Table 2 above) to manage hydromodification impacts: The project proponent may conduct an independent geomorphic study to determine the project's full hydromodification impact. The study must incorporate sediment transport modeling across the range of geomorphically-significant flows and demonstrate to the County's satisfaction that the project flows and sediment reductions will not detrimentally affect the receiving water to qualify for the exemption.

STORMWATER QUALITY DETERMINATION

The following questions provide a guide to collecting information relevant to project stormwater quality issues. Please provide the following information in a printed report accompanying this form.

Table 3

	QUESTIONS	COMPLETED	NA
1.	Describe the topography of the project area.	✓	
2.	Describe the local land use within the project area and adjacent areas.	✓	
3.	Evaluate the presence of dry weather flow.		✓
4.	Determine the receiving waters that may be affected by the project throughout all phases of development through completion (i.e., construction, long-term maintenance and operation).	✓	
5.	For the project limits, list the 303(d) impaired receiving water bodies and their constituents of concern.		✓
6.	Determine if there are any High Risk Areas (which is defined by the presence of municipal or domestic water supply reservoirs or groundwater percolation facilities) within the project limits.		✓
7.	Determine the Regional Board special requirements, including TMDLs, effluent limits, etc.		
8.	Determine the general climate of the project area. Identify annual rainfall and rainfall intensity curves.	✓	
9.	Determine the soil classification, permeability, erodibility, and depth to groundwater for Treatment BMP consideration.		✓
10.	Determine contaminated or hazardous soils within the project area.		✓
11.	Determine if this project is within the environmentally sensitive areas as defined on the maps in Appendix A of the <i>County of San Diego Standard Urban Storm Water Mitigation Plan for Land Development and Public Improvement Projects</i> .		✓
12.	Determine if this is an emergency project.		✓

WATERSHED

Please check the watershed(s) for the project.

<input type="checkbox"/> San Juan 901	<input type="checkbox"/> Santa Margarita 902	<input type="checkbox"/> San Luis Rey 903	<input type="checkbox"/> Carlsbad 904
<input checked="" type="checkbox"/> San Dieguito 905	<input type="checkbox"/> Penasquitos 906	<input type="checkbox"/> San Diego 907	<input type="checkbox"/> Sweetwater 909
<input type="checkbox"/> Otay 910	<input type="checkbox"/> Tijuana 911	<input type="checkbox"/> Whitewater 719	<input type="checkbox"/> Clark 720
<input type="checkbox"/> West Salton 721	<input type="checkbox"/> Anza Borrego 722	<input type="checkbox"/> Imperial 723	

Please provide the hydrologic sub-area and number(s)

Number	Name
905.41	Ramona HSA

Please provide the beneficial uses for Inland Surface Waters and Ground Waters.

Beneficial Uses can be obtained from the Water Quality Control Plan for the San Diego Basin, which is available at the Regional Board office or at

http://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/index.shtml

SURFACE WATERS	Hydrologic Unit Basin Number	MUN	AGR	IND	PROC	GWR	FRESH	POW	REC1	REC2	BIOL	WARM	COLD	WILD	RARE	SPWN
Inland Surface Waters																
Santa Maria Creek	5.41	X	X	X	X				X	X		X		X		
Hatfield Creek	5.41	X	X	X	X				X	X		X		X		
Ground Waters																
Ramona	5.41	X	X	X	X											

* Excepted from Municipal

X Existing Beneficial Use

0 Potential Beneficial Use

POLLUTANTS OF CONCERN

Using Table 4, identify pollutants that are anticipated to be generated from the proposed priority project categories. Pollutants associated with any hazardous material sites that have been remediated or are not threatened by the proposed project are not considered a pollutant of concern.

Table 4. Anticipated and Potential Pollutants Generated by Land Use Type

<i>PDP Categories</i>	<i>General Pollutant Categories</i>								
	Sediments	Nutrients	Heavy Metals	Organic Compounds	Trash & Debris	Oxygen Demanding Substances	Oil & Grease	Bacteria & Viruses	Pesticides
Detached Residential Development	X	X			X	X	X	X	X
Attached Residential Development	X	X			X	P ⁽¹⁾	P ⁽²⁾	P	X
Commercial Development 1 acre or greater	P ⁽¹⁾	P ⁽¹⁾		P ⁽²⁾	X	P ⁽⁵⁾	X	P ⁽³⁾	P ⁽⁵⁾
Heavy industry /industrial development	X		X	X	X	X	X		
Automotive Repair Shops			X	X ⁽⁴⁾⁽⁵⁾	X		X		
Restaurants					X	X	X	X	
Hillside Development >5,000 ft ²	X	X			X	X	X		X
Parking Lots	P ⁽¹⁾	P ⁽¹⁾	X		X	P ⁽¹⁾	X		P ⁽¹⁾
Retail Gasoline Outlets			X	X	X	X	X		
Streets, Highways & Freeways	X	P ⁽¹⁾	X	X ⁽⁴⁾	X	P ⁽⁵⁾	X		
<p>X = anticipated P = potential (1) A potential pollutant if landscaping exists on-site. (2) A potential pollutant if the project includes uncovered parking areas. (3) A potential pollutant if land use involves food or animal waste products. (4) Including petroleum hydrocarbons. (5) Including solvents.</p>									

Note: If other monitoring data that is relevant to the project is available. Please include as Attachment C.

CONSTRUCTION BMPs


Please check the construction BMPs that may be implemented during construction of the project. The applicant will be responsible for the placement and maintenance of the BMPs incorporated into the final project design.

- | | |
|--|--|
| <input checked="" type="checkbox"/> Silt Fence | <input checked="" type="checkbox"/> Desilting Basin |
| <input checked="" type="checkbox"/> Fiber Rolls | <input checked="" type="checkbox"/> Gravel Bag Berm |
| <input checked="" type="checkbox"/> Street Sweeping and Vacuuming | <input checked="" type="checkbox"/> Sandbag Barrier |
| <input checked="" type="checkbox"/> Storm Drain Inlet Protection | <input checked="" type="checkbox"/> Material Delivery and Storage |
| <input checked="" type="checkbox"/> Stockpile Management | <input checked="" type="checkbox"/> Spill Prevention and Control |
| <input checked="" type="checkbox"/> Solid Waste Management | <input checked="" type="checkbox"/> Concrete Waste Management |
| <input checked="" type="checkbox"/> Stabilized Construction Entrance/Exit | <input checked="" type="checkbox"/> Water Conservation Practices |
| <input checked="" type="checkbox"/> Dewatering Operations | <input checked="" type="checkbox"/> Paving and Grinding Operations |
| <input checked="" type="checkbox"/> Vehicle and Equipment Maintenance | |
| <input checked="" type="checkbox"/> Any minor slopes created incidental to construction and not subject to a major or minor grading permit shall be protected by covering with plastic or tarp prior to a rain event, and shall have vegetative cover reestablished within 180 days of completion of the slope and prior to final building approval. | |

EXCEPTIONAL THREAT TO WATER QUALITY DETERMINATION

Complete the checklist below to determine if a proposed project will pose an "exceptional threat to water quality," and therefore require Advanced Treatment Best Management Practices.

Table 5

No.	CRITERIA	YES	NO	INFORMATION
1.	Is all or part of the proposed project site within 200 feet of waters named on the Clean Water Act (CWA) Section 303(d) list of Water Quality Limited Segments as impaired for sedimentation and/or turbidity? Current 303d list may be obtained from the following site: http://www.swrcb.ca.gov/tmdl/docs/303dlists2006/approved/r9_06_303d_req_tmdls.pdf			If YES, continue to 2. If NO, go to 5.
2.	Will the project disturb more than 5 acres, including all phases of the development?			If YES, continue to 3. If NO, go to 5.
3.	Will the project disturb slopes that are steeper than 4:1 (horizontal: vertical) with at least 10 feet of relief, and that drain toward the 303(d) listed receiving water for sedimentation and/or turbidity?			If YES, continue to 4. If NO, go to 5.
4.	Will the project disturb soils with a predominance of USDA-NRCS Erosion factors k_f greater than or equal to 0.4?			If YES, continue to 6. If NO, go to 5.
5.	Project is not required to use Advanced Treatment BMPs.			Document for Project Files by referencing this checklist.
6.	Project poses an "exceptional threat to water quality" and is required to use Advanced Treatment BMPs.			Advanced Treatment BMPs must be consistent with WPO section 67.811(b)(20)(D) performance criteria

Exemption potentially available for projects that require advanced treatment:

Project proponent may perform a Revised Universal Soil Loss Equation, Version 2 (RUSLE 2), Modified Universal Soil Loss Equation (MUSLE), or similar analysis that shows to the County official's satisfaction that advanced treatment is not required

Now that the need for treatment BMPs has been determined, other information is needed to complete the SWMP.

SITE DESIGN

To minimize stormwater impacts, site design measures must be addressed. The following checklist provides options for avoiding or reducing potential impacts during project planning. If YES is checked, it is assumed that the measure was used for this project.

Table 6

	OPTIONS	YES	NO	N/A
1.	Has the project been located and road improvements aligned to avoid or minimize impacts to receiving waters or to increase the preservation of critical (or problematic) areas such as floodplains, steep slopes, wetlands, and areas with erosive or unstable soil conditions?	✓		
2.	Is the project designed to minimize impervious footprint?	✓		
3.	Is the project conserving natural areas where feasible?	✓		
4.	Where landscape is proposed, are rooftops, impervious sidewalks, walkways, trails and patios be drained into adjacent landscaping?	✓		
5.	For roadway projects, are structures and bridges be designed or located to reduce work in live streams and minimize construction impacts?			✓
6.	Can any of the following methods be utilized to minimize erosion from slopes:			
6.a.	Disturbing existing slopes only when necessary?	✓		
6.b.	Minimize cut and fill areas to reduce slope lengths?	✓		
6.c.	Incorporating retaining walls to reduce steepness of slopes or to shorten slopes?	✓		
6.d.	Providing benches or terraces on high cut and fill slopes to reduce concentration of flows?			✓
6.e.	Rounding and shaping slopes to reduce concentrated flow?	✓		
6.f.	Collecting concentrated flows in stabilized drains and channels?	✓		

LOW IMPACT DEVELOPMENT (LID)

Each numbered item below is a LID requirement of the WPO. Please check the box(s) under each number that best describes the Low Impact Development BMP(s) selected for this project.

Table 7

1. Conserve natural Areas, Soils, and Vegetation-County LID Handbook 2.2.1
<input type="checkbox"/> Preserve well draining soils (Type A or B)
<input type="checkbox"/> Preserve Significant Trees
<input type="checkbox"/> Other. Description:
<input checked="" type="checkbox"/> 1. Not feasible. State Reason: Proposed project will develop the entire site leaving no natural ground untouched.
2. Minimize Disturbance to Natural Drainages-County LID Handbook 2.2.2
<input type="checkbox"/> Set-back development envelope from drainages
Restrict heavy construction equipment access to planned green/open space areas
<input type="checkbox"/> Other. Description:
<input checked="" type="checkbox"/> 2. Not feasible. State Reason: Proposed project will develop the entire site. Drainage will outfall at the same location with the same velocity.
3. Minimize and Disconnect Impervious Surfaces (see 5) -County LID Handbook 2.2.3
<input type="checkbox"/> Clustered Lot Design
<input checked="" type="checkbox"/> Items checked in 5?
<input checked="" type="checkbox"/> Other. Description: Proposed project has vegetated swales between each unit and pathway. Only 54% of the site will be impervious and the the water runoff will be filtered through swales and allowed to infiltrate within an subterranean system.
<input type="checkbox"/> 3. Not feasible. State Reason:
4. Minimize Soil Compaction-County LID Handbook 2.2.4
Restrict heavy construction equipment access to planned green/open space areas
<input checked="" type="checkbox"/> Re-till soils compacted by construction vehicles/equipment
Collect & re-use upper soil layers of development site containing organic materials
<input type="checkbox"/> Other. Description:
4. Not feasible. State Reason:
5. Drain Runoff from Impervious Surfaces to Pervious Areas-County LID Handbook 2.2.5

LID Street & Road Design
<input checked="" type="checkbox"/> Curb-cuts to landscaping
<input type="checkbox"/> Rural Swales
<input type="checkbox"/> Concave Median
<input type="checkbox"/> Cul-de-sac Landscaping Design
<input type="checkbox"/> Other. Description:
LID Parking Lot Design
<input type="checkbox"/> Permeable Pavements
<input checked="" type="checkbox"/> Curb-cuts to landscaping
<input type="checkbox"/> Other. Description:
LID Driveway, Sidewalk, Bike-path Design
<input type="checkbox"/> Permeable Pavements
<input type="checkbox"/> Pitch pavements toward landscaping
<input checked="" type="checkbox"/> Other. Description: The proposed project uses a shared private driveway for all units. All run off is routed through a bio-swale before entering a subterranean infiltration system.
LID Building Design
<input type="checkbox"/> Cisterns & Rain Barrels
<input checked="" type="checkbox"/> Downspout to swale
<input type="checkbox"/> Vegetated Roofs
<input type="checkbox"/> Other. Description:
LID Landscaping Design
<input type="checkbox"/> Soil Amendments
<input type="checkbox"/> Reuse of Native Soils
<input checked="" type="checkbox"/> Smart Irrigation Systems
<input checked="" type="checkbox"/> Street Trees
<input type="checkbox"/> Other. Description:
<input type="checkbox"/> 5. Not feasible. State Reason:

CHANNELS & DRAINAGES

Complete the following checklist to determine if the project includes work in channels.

Table 8

No.	CRITERIA	YES	NO	N/A	COMMENTS
1.	Will the project include work in channels?		<input checked="" type="checkbox"/>		If YES go to 2 If NO go to 13.
2.	Will the project increase velocity or volume of downstream flow?				If YES go to 6.
3.	Will the project discharge to unlined channels?				If YES go to 6.
4.	Will the project increase potential sediment load of downstream flow?				If YES go to 6.
5.	Will the project encroach, cross, realign, or cause other hydraulic changes to a stream that may affect downstream channel stability?				If YES go to 8.
6.	Review channel lining materials and design for stream bank erosion.				Continue to 7.
7.	Consider channel erosion control measures within the project limits as well as downstream. Consider scour velocity.				Continue to 8.
8.	Include, where appropriate, energy dissipation devices at culverts.				Continue to 9.
9.	Ensure all transitions between culvert outlets/headwalls/wingwalls and channels are smooth to reduce turbulence and scour.				Continue to 10.
10.	Include, if appropriate, detention facilities to reduce peak discharges.				Continue to 11.
11.	"Hardening" natural downstream areas to prevent erosion is not an acceptable technique for protecting channel slopes, unless pre-development conditions are determined to be so erosive that hardening would be required even in the absence of the proposed development.				Continue to 12.
12.	Provide other design principles that are comparable and equally effective.				Continue to 13.
13.	End				

SOURCE CONTROL

Please complete the following checklist for Source Control BMPs. If the BMP is not applicable for this project, then check N/A only at the main category.

Table 9

BMP		YES	NO	N/A
1.	Provide Storm Drain System Stenciling and Signage			
1.a.	All storm drain inlets and catch basins within the project area shall have a stencil or tile placed with prohibitive language (such as: "NO DUMPING – DRAINS TO _____") and/or graphical icons to discourage illegal dumping.	✓		
1.b.	Signs and prohibitive language and/or graphical icons, which prohibit illegal dumping, must be posted at public access points along channels and creeks within the project area.		✓	
2.	Design Outdoors Material Storage Areas to Reduce Pollution Introduction			
2.a.	This is a detached single-family residential project. Therefore, personal storage areas are exempt from this requirement.	✓		
2.b.	Hazardous materials with the potential to contaminate urban runoff shall either be: (1) placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with runoff or spillage to the storm water conveyance system; or (2) protected by secondary containment structures such as berms, dikes, or curbs.		✓	
2.c.	The storage area shall be paved and sufficiently impervious to contain leaks and spills.		✓	
2.d.	The storage area shall have a roof or awning to minimize direct precipitation within the secondary containment area.		✓	
3.	Design Trash Storage Areas to Reduce Pollution Introduction			✓
3.a.	Paved with an impervious surface, designed not to allow run-on from adjoining areas, screened or walled to prevent off-site transport of trash; or,			
3.b.	Provide attached lids on all trash containers that exclude rain, or roof or awning to minimize direct precipitation.			
4.	Use Efficient Irrigation Systems & Landscape Design			
	The following methods to reduce excessive irrigation runoff shall be considered, and incorporated and implemented where determined applicable and feasible.			
4.a.	Employing rain shutoff devices to prevent irrigation after precipitation.		✓	
4.b.	Designing irrigation systems to each landscape area's specific water requirements.	✓		
4.c.	Using flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.		✓	
4.d.	Employing other comparable, equally effective, methods to reduce irrigation water runoff.	✓		
5.	Private Roads			

BMP		YES	NO	N/A
	The design of private roadway drainage shall use at least one of the following			
5.a.	Rural swale system: street sheet flows to vegetated swale or gravel shoulder, curbs at street corners, culverts under driveways and street crossings.		✓	
5.b.	Urban curb/swale system: street slopes to curb, periodic swale inlets drain to vegetated swale/biofilter.	✓		
5.c.	Dual drainage system: First flush captured in street catch basins and discharged to adjacent vegetated swale or gravel shoulder, high flows connect directly to storm water conveyance system.		✓	
5.d.	Other methods that are comparable and equally effective within the project.		✓	
6.	Residential Driveways & Guest Parking			
	The design of driveways and private residential parking areas shall use one at least of the following features.			
6.a.	Design driveways with shared access, flared (single lane at street) or wheelstrips (paving only under tires); or, drain into landscaping prior to discharging to the storm water conveyance system.	✓		
6.b.	Uncovered temporary or guest parking on private residential lots may be: paved with a permeable surface; or, designed to drain into landscaping prior to discharging to the storm water conveyance system.	✓		
6.c.	Other features which are comparable and equally effective.		✓	✓
7.	Dock Areas			
	Loading/unloading dock areas shall include the following.			
7.a.	Cover loading dock areas, or design drainage to preclude urban run-on and runoff.			
7.b.	Direct connections to storm drains from depressed loading docks (truck wells) are prohibited.			
7.c.	Other features which are comparable and equally effective.			✓
8.	Maintenance Bays			
	Maintenance bays shall include the following.			
8.a.	Repair/maintenance bays shall be indoors; or, designed to preclude urban run-on and runoff.			
8.b.	Design a repair/maintenance bay drainage system to capture all wash water, leaks and spills. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.			
8.c.	Other features which are comparable and equally effective.			✓
9.	Vehicle Wash Areas			
	Priority projects that include areas for washing/steam cleaning of vehicles shall use the following.			
9.a.	Self-contained; or covered with a roof or overhang.			
9.b.	Equipped with a clarifier or other pretreatment facility.			
9.c.	Properly connected to a sanitary sewer.			
9.d.	Other features which are comparable and equally effective.			

BMP		YES	NO	N/A
10.	Outdoor Processing Areas			✓
	Outdoor process equipment operations, such as rock grinding or crushing, painting or coating, grinding or sanding, degreasing or parts cleaning, waste piles, and wastewater and solid waste treatment and disposal, and other operations determined to be a potential threat to water quality by the County shall adhere to the following requirements.			
	10.a. Cover or enclose areas that would be the most significant source of pollutants; or, slope the area toward a dead-end sump; or, discharge to the sanitary sewer system following appropriate treatment in accordance with conditions established by the applicable sewer agency.			
	10.b. Grade or berm area to prevent run-on from surrounding areas.			
	10.c. Installation of storm drains in areas of equipment repair is prohibited.			
	10.d. Other features which are comparable or equally effective.			
11.	Equipment Wash Areas			✓
	Outdoor equipment/accessory washing and steam cleaning activities shall be.			
	11.a. Be self-contained; or covered with a roof or overhang.			
	11.b. Be equipped with a clarifier, grease trap or other pretreatment facility, as appropriate			
	11.c. Be properly connected to a sanitary sewer.			
	11.d. Other features which are comparable or equally effective.			
12.	Parking Areas			✓
	The following design concepts shall be considered, and incorporated and implemented where determined applicable and feasible by the County.			
	12.a. Where landscaping is proposed in parking areas, incorporate landscape areas into the drainage design.			
	12.b. Overflow parking (parking stalls provided in excess of the County's minimum parking requirements) may be constructed with permeable paving.			
	12.c. Other design concepts that are comparable and equally effective.			
13.	Fueling Area			✓
	Non-retail fuel dispensing areas shall contain the following.			
	13.a. Overhanging roof structure or canopy. The cover's minimum dimensions must be equal to or greater than the area within the grade break. The cover must not drain onto the fuel dispensing area and the downspouts must be routed to prevent drainage across the fueling area. The fueling area shall drain to the project's treatment control BMP(s) prior to discharging to the storm water conveyance system.			
	13.b. Paved with Portland cement concrete (or equivalent smooth impervious surface). The use of asphalt concrete shall be prohibited.			
	13.c. Have an appropriate slope to prevent ponding, and must be separated from the rest of the site by a grade break that prevents run-on of urban runoff.			

BMP			YES	NO	N/A
	13.d.	At a minimum, the concrete fuel dispensing area must extend 6.5 feet (2.0 meters) from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 foot (0.3 meter), whichever is less.			

Please list other project specific Source Control BMPs in the following box. Write N/A if there are none.

N/A

TREATMENT CONTROL

To select a structural treatment BMP using Treatment Control BMP Selection Matrix (Table 10), each priority project shall compare the list of pollutants for which the downstream receiving waters are impaired (if any), with the pollutants anticipated to be generated by the project (as identified in Table 4). Any pollutants identified by Table 4, which are also causing a Clean Water Act section 303(d) impairment of the receiving waters of the project, shall be considered primary pollutants of concern. Priority projects that are anticipated to generate a primary pollutant of concern shall select a single or combination of stormwater BMPs from Table 10, which **maximizes pollutant removal** for the particular primary pollutant(s) of concern.

Priority development projects that are **not** anticipated to generate a pollutant for which the receiving water is CWA 303(d) impaired shall select a single or combination of stormwater BMPs from Table 10, which are effective for pollutant removal of the identified secondary pollutants of concern, consistent with the "maximum extent practicable" standard.

Table 10. Treatment Control BMP Selection Matrix

Pollutants of Concern	Bioretention Facilities (LID)*	Settling Basins (Dry Ponds)	Wet Ponds and Wetlands	Infiltration Facilities or Practices (LID)*	Media Filters	High-rate biofilters	High-rate media filters	Trash Racks & Hydro-dynamic Devices
Coarse Sediment and Trash	High	High	High	High	High	High	High	High
Pollutants that tend to associate with fine particles during treatment	High	High	High	High	High	Medium	Medium	Low
Pollutants that tend to be dissolved following treatment	Medium	Low	Medium	High	Low	Low	Low	Low

*Additional information is available in the County of San Diego LID Handbook.

NOTES ON POLLUTANTS OF CONCERN:

In Table 11, Pollutants of Concern are grouped as gross pollutants, pollutants that tend to associate with fine particles, and pollutants that remain dissolved.

Table 11

Pollutant	Coarse Sediment and Trash	Pollutants that tend to associate with fine particles during treatment	Pollutants that tend to be dissolved following treatment
Sediment	X	X	
Nutrients		X	X
Heavy Metals		X	
Organic Compounds		X	
Trash & Debris	X		
Oxygen Demanding		X	
Bacteria		X	
Oil & Grease		X	
Pesticides		X	

A Treatment BMP must address runoff from developed areas. Please provide the post-construction water quality treatment volume or flow values for the selected project Treatment BMP(s). Guidelines for design calculations are located in Chapter 5, Section 4.3, Principle 8 of the County SUSMP. Label outfalls on the BMP map. The Water Quality peak rate of discharge flow (Q_{WQ}) and the Water Quality storage volume (V_{WQ}) is dependent on the type of treatment BMP selected for the project.

Outfall	Tributary Area (acres)	Q_{WQ} (cfs)	V_{WQ} (ft ³)
A 1-4 + B-1	2.72	0.34	122
B-2	0.61	0.08	29

Please check the box(s) that best describes the Treatment BMP(s) selected for this project.

Biofilters
<input type="checkbox"/> Bioretention swale
<input checked="" type="checkbox"/> Vegetated filter strip
<input type="checkbox"/> Stormwater Planter Box (open-bottomed)
<input type="checkbox"/> Stormwater Flow-Through Planter (sealed bottom)
<input type="checkbox"/> Bioretention Area
<input type="checkbox"/> Vegetated Roofs/Modules/Walls
Detention Basins
<input type="checkbox"/> Extended/dry detention basin with grass/vegetated lining
<input type="checkbox"/> Extended/dry detention basin with impervious lining
Infiltration Basins
<input type="checkbox"/> Infiltration basin
<input type="checkbox"/> Infiltration trench
<input type="checkbox"/> Dry well
<input type="checkbox"/> Permeable Paving
<input type="checkbox"/> Gravel
<input type="checkbox"/> Permeable asphalt
<input type="checkbox"/> Pervious concrete
<input type="checkbox"/> Unit pavers, ungrouted, set on sand or gravel
<input type="checkbox"/> Subsurface reservoir bed
Wet Ponds or Wetlands
<input type="checkbox"/> Wet pond/basin (permanent pool)
<input type="checkbox"/> Constructed wetland
Filtration
<input checked="" type="checkbox"/> Media filtration
<input type="checkbox"/> Sand filtration
Hydrodynamic Separator Systems
<input type="checkbox"/> Swirl Concentrator
<input type="checkbox"/> Cyclone Separator
Trash Racks and Screens

Include Treatment Datasheet as Attachment E. The datasheet should include the following:	COMPLETED	NO
1. Description of how treatment BMP was designed. Provide a description for each type of treatment BMP.	<input checked="" type="checkbox"/>	
2. Engineering calculations for the BMP(s)	<input checked="" type="checkbox"/>	

Please describe why the selected treatment BMP(s) was selected for this project. For projects utilizing a low performing BMP, please provide a detailed explanation.

The proposed project intends to use curb cuts to route runoff from impervious conditions to travel through bio-swales before entering, via area drains, a subterranean filtration/retention system. Down spouts from buildings are directed into a vegetated bio-swales before entering area drains and ending at the filtration/retention system detailed in the permanent BMP sheet enclosed in this report. Out flow from the site is regulated through a Brooks Box containing a detention control standpipe (riser) keeping outflow at the pre-development rates, of 1.64, 2.46 and 3.58 for the 2-yr, 10-yr and 100-yr storms, respectively.

MAINTENANCE

Please check the box that best describes the maintenance mechanism(s) for this project. Guidelines for each category are located in Chapter 5, Section 5.2 of the County SUSMP.

CATEGORY	SELECTED	
	YES	NO
First	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Second ¹	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Third ¹	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Fourth	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Note:

1. Projects in Category 2 or 3 may choose to establish or be included in a Stormwater Maintenance Assessment District for the long-term maintenance of treatment BMPs.

ATTACHMENTS

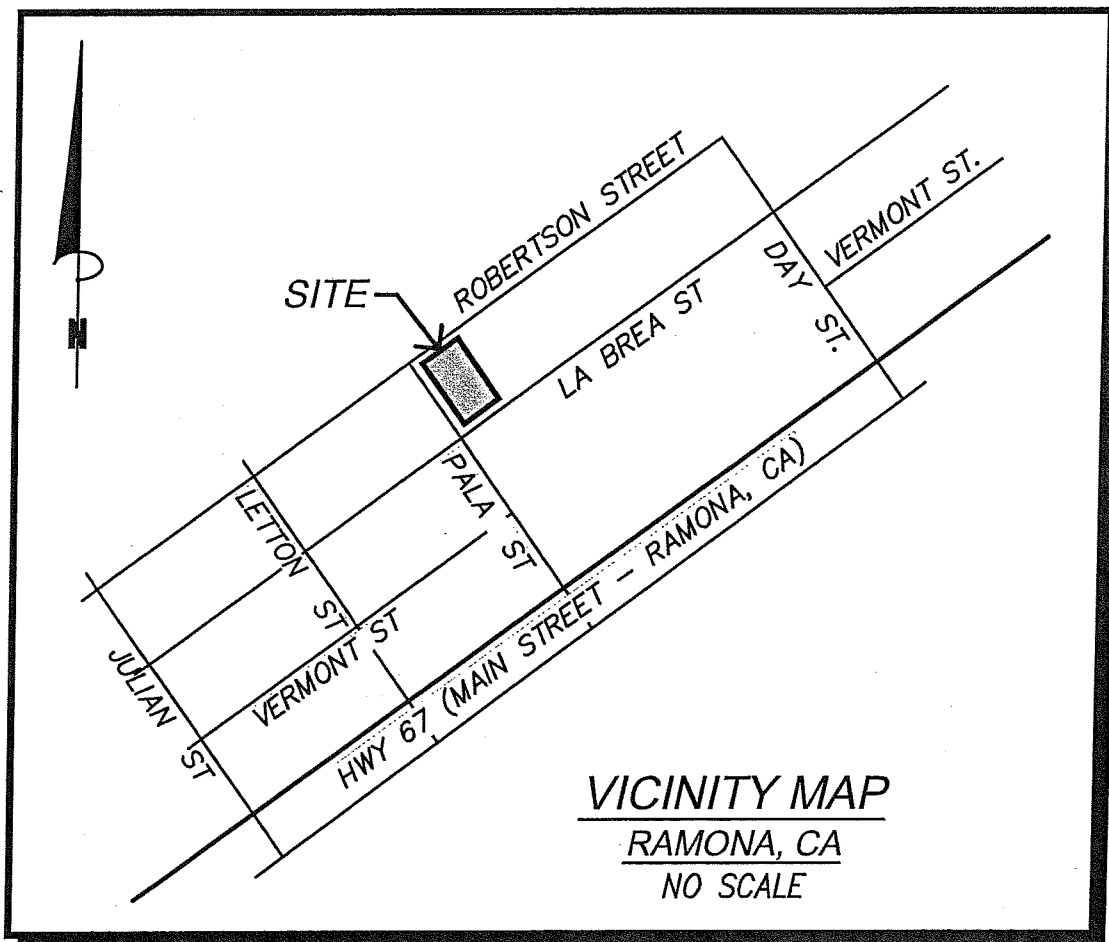
Please include the following attachments.

ATTACHMENT		COMPLETED	N/A
A	Project Location Map	<input checked="" type="checkbox"/>	<input type="checkbox"/>
B	Site Map	<input checked="" type="checkbox"/>	<input type="checkbox"/>
C	Relevant Monitoring Data	<input type="checkbox"/>	<input checked="" type="checkbox"/>
D	LID and Treatment BMP Location Map	<input checked="" type="checkbox"/>	<input type="checkbox"/>
E	Treatment BMP Datasheets	<input checked="" type="checkbox"/>	<input type="checkbox"/>
F	Operation and Maintenance Program for Treatment BMPs	<input checked="" type="checkbox"/>	<input type="checkbox"/>
G	Fiscal Resources	<input type="checkbox"/>	<input checked="" type="checkbox"/>
H	Certification Sheet	<input checked="" type="checkbox"/>	<input type="checkbox"/>
I	Addendum	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Note: Attachments A and B may be combined.

ATTACHMENT A

PROJECT LOCATION MAP



ATTACHMENT B

PROJECT SITE MAP

(SEE ATTACHMENT A)

ATTACHMENT C

RELEVANT MONITORING DATA

(NOTE: PROVIDE RELEVANT WATER QUALITY MONITORING DATA IF AVAILABLE.)

(N/A)

ATTACHMENT D

LID AND TREATMENT BMP LOCATION MAP

(SEE PLAN IN BACK FOLDER)

ATTACHMENT E

TREATMENT BMP DATASHEET

*(NOTE: POSSIBLE SOURCE FOR DATASHEETS CAN BE FOUND AT
WWW.CABMPHANDBOOKS.COM. INCLUDE ENGINEERING CALCULATIONS FOR SIZING
THE TREATMENT BMP.)*

Village Walk Townhomes

DETENTION VOLUME CALCULATIONS

	Runoff Hydrograph			Outflow Hydrograph		Detention
Frequency	Time (min)	Q (cfs)	Volume (cuft)	Q (cfs)	Volume (cuft)	Required Storage (cuft)

85 Percentile	0	0.000	0.00	0.000	0.00	0.00
	1	0.120	3.60	0.022	1.34	5.86
	2	0.240	14.40	0.045	4.02	17.58
	3	0.360	32.40	0.067	8.05	35.15
	4	0.480	57.60	0.089	13.41	58.59
	5	0.600	90.00	0.112	20.12	87.88
	6	0.720	129.59	0.134	28.16	123.03
	7	0.840	176.39	0.156	37.55	164.04
	8	0.960	230.39	0.179	48.28	210.91
	9	1.080	291.59	0.201	60.35	263.63
	10	1.200	359.99	0.224	73.76	322.22
	11	1.080	428.38	0.246	88.52	372.26
	12	0.960	489.58	0.268	104.61	413.77
	13	0.840	543.58	0.291	122.05	446.73
	14	0.720	590.38	0.313	140.82	471.15
	15	0.600	629.97	0.335	160.94	487.03
	16	0.480	662.57	0.358	182.40	494.37
	17	0.360	687.57	0.380	205.20	494.37
	18	0.240	705.57	0.358	226.66	0.00
	19	0.120	716.37	0.335	246.78	0.00
	20	0.000	719.97	0.313	265.55	0.00

2 Year	0	0.000	0.00	0.000	0.00	0.00
	1	0.226	6.78	0.044	2.61	10.94
	2	0.452	27.10	0.087	7.84	32.82
	3	0.678	60.99	0.131	15.67	65.64
	4	0.903	108.42	0.174	26.12	109.41
	5	1.129	169.40	0.218	39.18	164.11
	6	1.355	243.94	0.261	54.85	229.75
	7	1.581	332.03	0.305	73.13	306.34
	8	1.807	433.68	0.348	94.02	393.86
	9	2.033	548.87	0.392	117.53	492.33
	10	2.259	677.62	0.435	143.65	601.73
	11	2.033	806.37	0.479	172.38	694.98
	12	1.807	921.56	0.522	203.72	772.05
	13	1.581	1,023.00	0.566	237.67	832.97
	14	1.355	1,111.00	0.609	274.24	877.72
	15	1.129	1,186.00	0.653	313.41	906.30
	16	0.903	1,247.00	0.696	355.20	918.72
	17	0.678	1,294.00	0.740	399.60	918.72
	18	0.452	1,328.00	0.696	441.39	0.00
	19	0.226	1,348.00	0.653	480.56	0.00
	20	0.000	1,355.00	0.609	517.13	0.00

Village Walk Townhomes

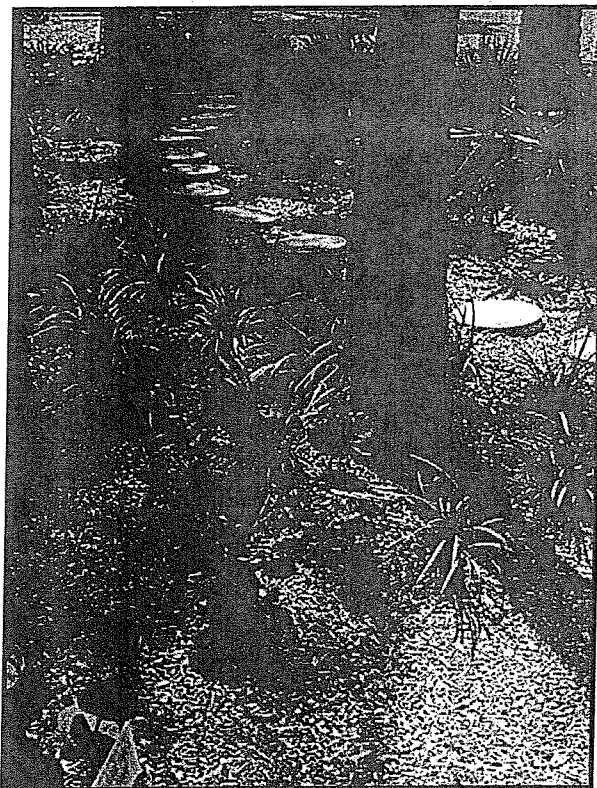
DETENTION VOLUME CALCULATIONS

Frequency	Runoff Hydrograph			Outflow Hydrograph		Detention
	Time (min)	Q (cfs)	Volume (cuft)	Q (cfs)	Volume (cuft)	Required Storage (cuft)

10 Year	0	0.000	0.00	0.000	0.00	0.00
	1	0.339	10.16	0.065	3.92	16.40
	2	0.677	40.64	0.131	11.75	49.21
	3	1.016	91.45	0.196	23.51	98.42
	4	1.355	162.57	0.261	39.18	164.04
	5	1.693	254.02	0.326	58.76	246.06
	6	2.032	365.79	0.392	82.27	344.49
	7	2.371	497.88	0.457	109.69	459.31
	8	2.710	650.30	0.522	141.04	590.55
	9	3.048	823.03	0.588	176.29	738.18
	10	3.387	1,016.00	0.653	215.47	902.22
	11	3.048	1,209.00	0.718	258.56	1,042.00
	12	2.710	1,382.00	0.784	305.58	1,158.00
	13	2.371	1,534.00	0.849	356.51	1,249.00
	14	2.032	1,666.00	0.914	411.35	1,316.00
	15	1.693	1,778.00	0.979	470.12	1,359.00
	16	1.355	1,870.00	1.045	532.80	1,377.00
	17	1.016	1,941.00	1.110	599.40	1,377.00
	18	0.677	1,992.00	1.045	662.08	0.00
	19	0.339	2,022.00	0.979	720.85	0.00
	20	0.000	2,032.00	0.914	775.69	0.00

100 Year	0	0.000	0.00	0.000	0.00	0.00
	1	0.494	14.82	0.096	5.75	23.89
	2	0.988	59.29	0.192	17.26	71.68
	3	1.482	133.41	0.288	34.52	143.36
	4	1.976	237.17	0.384	57.53	238.93
	5	2.470	370.57	0.479	86.29	358.39
	6	2.965	533.62	0.575	120.81	501.75
	7	3.459	726.32	0.671	161.08	669.00
	8	3.953	948.67	0.767	207.11	860.14
	9	4.447	1,201.00	0.863	258.88	1,075.00
	10	4.941	1,482.00	0.959	316.41	1,314.00
	11	4.447	1,764.00	1.055	379.69	1,518.00
	12	3.953	2,016.00	1.151	448.73	1,686.00
	13	3.459	2,238.00	1.246	523.52	1,819.00
	14	2.965	2,431.00	1.342	604.06	1,916.00
	15	2.470	2,594.00	1.438	690.35	1,978.00
	16	1.976	2,727.00	1.534	782.40	2,004.00
	17	1.482	2,831.00	1.630	880.20	2,004.00
	18	0.988	2,905.00	1.534	972.25	0.00
	19	0.494	2,950.00	1.438	1,059.00	0.00
	20	0.000	2,965.00	1.342	1,139.00	0.00

Site Design & Landscape Planning SD-10



Design Objectives

- ☒ Maximize Infiltration
- ☒ Provide Retention
- ☒ Slow Runoff
- ☒ Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

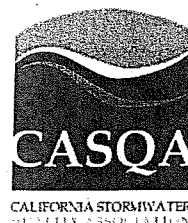
Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.



SD-10 Site Design & Landscape Planning

Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.
- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.
- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.
- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Promote natural vegetation by using parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.
- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

Site Design & Landscape Planning SD-10

regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of "redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

SD-10 Site Design & Landscape Planning

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.



Rain Garden

Design Objectives

- ☒ Maximize Infiltration
- ☒ Provide Retention
- ☒ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☒ Contain Pollutants
- Collect and Convey

Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain



barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say 1/4 to 1/2 inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry wells and Infiltration Trenches

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

Pop-up Drainage Emitter

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

Foundation Planting

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

Supplemental Information

Examples

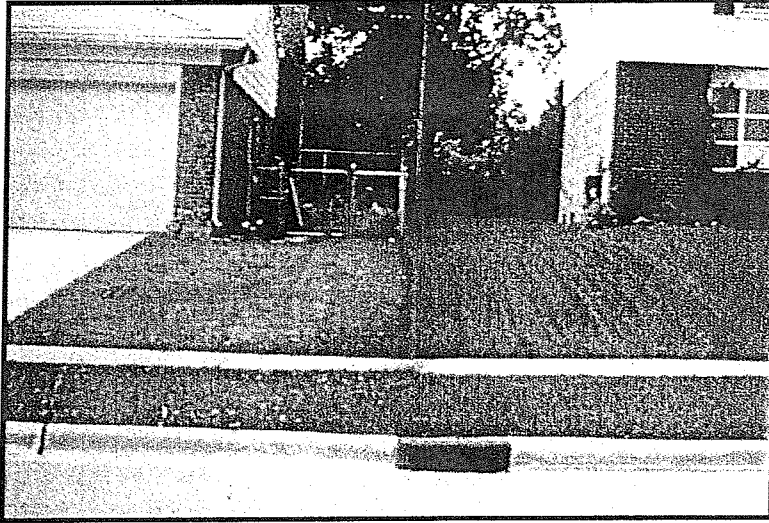
- City of Ottawa’s Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

Other Resources

Hager, Marty Catherine, Stormwater, “Low-Impact Development”, January/February 2003.
www.stormh2o.com

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD.
www.lid-stormwater.net

Start at the Source, Bay Area Stormwater Management Agencies Association, 1999 Edition



Design Objectives

- ☒ Maximize Infiltration
- ☒ Provide Retention
- ☒ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.



- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
 - Using mulches (such as wood chips or bark) in planter areas without ground cover to minimize sediment in runoff
 - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
 - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
 - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

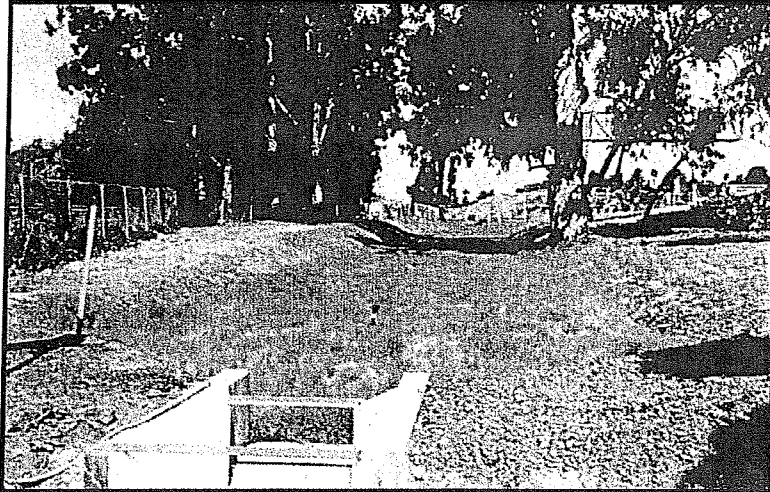
Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.



Description

Vegetated swales are open, shallow channels with vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. They are designed to treat runoff through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Swales can be natural or manmade. They trap particulate pollutants (suspended solids and trace metals), promote infiltration, and reduce the flow velocity of stormwater runoff. Vegetated swales can serve as part of a stormwater drainage system and can replace curbs, gutters and storm sewer systems.

California Experience

Caltrans constructed and monitored six vegetated swales in southern California. These swales were generally effective in reducing the volume and mass of pollutants in runoff. Even in the areas where the annual rainfall was only about 10 inches/yr, the vegetation did not require additional irrigation. One factor that strongly affected performance was the presence of large numbers of gophers at most of the sites. The gophers created earthen mounds, destroyed vegetation, and generally reduced the effectiveness of the controls for TSS reduction.

Advantages

- If properly designed, vegetated, and operated, swales can serve as an aesthetic, potentially inexpensive urban development or roadway drainage conveyance measure with significant collateral water quality benefits.

Design Considerations

- Tributary Area
- Area Required
- Slope
- Water Availability

Targeted Constituents

☑ Sediment	▲
☑ Nutrients	●
☑ Trash	●
☑ Metals	▲
☑ Bacteria	●
☑ Oil and Grease	▲
☑ Organics	▲

Legend (Removal Effectiveness)

- Low
- High
- ▲ Medium



- Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible.

Limitations

- Can be difficult to avoid channelization.
- May not be appropriate for industrial sites or locations where spills may occur
- Grassed swales cannot treat a very large drainage area. Large areas may be divided and treated using multiple swales.
- A thick vegetative cover is needed for these practices to function properly.
- They are impractical in areas with steep topography.
- They are not effective and may even erode when flow velocities are high, if the grass cover is not properly maintained.
- In some places, their use is restricted by law: many local municipalities require curb and gutter systems in residential areas.
- Swales are more susceptible to failure if not properly maintained than other treatment BMPs.

Design and Sizing Guidelines

- Flow rate based design determined by local requirements or sized so that 85% of the annual runoff volume is discharged at less than the design rainfall intensity.
- Swale should be designed so that the water level does not exceed 2/3rds the height of the grass or 4 inches, whichever is less, at the design treatment rate.
- Longitudinal slopes should not exceed 2.5%
- Trapezoidal channels are normally recommended but other configurations, such as parabolic, can also provide substantial water quality improvement and may be easier to mow than designs with sharp breaks in slope.
- Swales constructed in cut are preferred, or in fill areas that are far enough from an adjacent slope to minimize the potential for gopher damage. Do not use side slopes constructed of fill, which are prone to structural damage by gophers and other burrowing animals.
- A diverse selection of low growing, plants that thrive under the specific site, climatic, and watering conditions should be specified. Vegetation whose growing season corresponds to the wet season are preferred. Drought tolerant vegetation should be considered especially for swales that are not part of a regularly irrigated landscaped area.
- The width of the swale should be determined using Manning's Equation using a value of 0.25 for Manning's n.

Construction/Inspection Considerations

- Include directions in the specifications for use of appropriate fertilizer and soil amendments based on soil properties determined through testing and compared to the needs of the vegetation requirements.
- Install swales at the time of the year when there is a reasonable chance of successful establishment without irrigation; however, it is recognized that rainfall in a given year may not be sufficient and temporary irrigation may be used.
- If sod tiles must be used, they should be placed so that there are no gaps between the tiles; stagger the ends of the tiles to prevent the formation of channels along the swale or strip.
- Use a roller on the sod to ensure that no air pockets form between the sod and the soil.
- Where seeds are used, erosion controls will be necessary to protect seeds for at least 75 days after the first rainfall of the season.

Performance

The literature suggests that vegetated swales represent a practical and potentially effective technique for controlling urban runoff quality. While limited quantitative performance data exists for vegetated swales, it is known that check dams, slight slopes, permeable soils, dense grass cover, increased contact time, and small storm events all contribute to successful pollutant removal by the swale system. Factors decreasing the effectiveness of swales include compacted soils, short runoff contact time, large storm events, frozen ground, short grass heights, steep slopes, and high runoff velocities and discharge rates.

Conventional vegetated swale designs have achieved mixed results in removing particulate pollutants. A study performed by the Nationwide Urban Runoff Program (NURP) monitored three grass swales in the Washington, D.C., area and found no significant improvement in urban runoff quality for the pollutants analyzed. However, the weak performance of these swales was attributed to the high flow velocities in the swales, soil compaction, steep slopes, and short grass height.

Another project in Durham, NC, monitored the performance of a carefully designed artificial swale that received runoff from a commercial parking lot. The project tracked 11 storms and concluded that particulate concentrations of heavy metals (Cu, Pb, Zn, and Cd) were reduced by approximately 50 percent. However, the swale proved largely ineffective for removing soluble nutrients.

The effectiveness of vegetated swales can be enhanced by adding check dams at approximately 17 meter (50 foot) increments along their length (See Figure 1). These dams maximize the retention time within the swale, decrease flow velocities, and promote particulate settling. Finally, the incorporation of vegetated filter strips parallel to the top of the channel banks can help to treat sheet flows entering the swale.

Only 9 studies have been conducted on all grassed channels designed for water quality (Table 1). The data suggest relatively high removal rates for some pollutants, but negative removals for some bacteria, and fair performance for phosphorus.

Table 1 Grassed swale pollutant removal efficiency data							
Removal Efficiencies (% Removal)							
Study	TSS	TP	TN	NO ₃	Metals	Bacteria	Type
Caltrans 2002	77	8	67	66	83-90	-33	dry swales
Goldberg 1993	67.8	4.5	-	31.4	42-62	-100	grassed channel
Seattle Metro and Washington Department of Ecology 1992	60	45	-	-25	2-16	-25	grassed channel
Seattle Metro and Washington Department of Ecology, 1992	83	29	-	-25	46-73	-25	grassed channel
Wang et al., 1981	80	-	-	-	70-80	-	dry swale
Dorman et al., 1989	98	18	-	45	37-81	-	dry swale
Harper, 1988	87	83	84	80	88-90	-	dry swale
Kercher et al., 1983	99	99	99	99	99	-	dry swale
Harper, 1988.	81	17	40	52	37-69	-	wet swale
Koon, 1995	67	39	-	9	-35 to 6	-	wet swale

While it is difficult to distinguish between different designs based on the small amount of available data, grassed channels generally have poorer removal rates than wet and dry swales, although some swales appear to export soluble phosphorus (Harper, 1988; Koon, 1995). It is not clear why swales export bacteria. One explanation is that bacteria thrive in the warm swale soils.

Siting Criteria

The suitability of a swale at a site will depend on land use, size of the area serviced, soil type, slope, imperviousness of the contributing watershed, and dimensions and slope of the swale system (Schueler et al., 1992). In general, swales can be used to serve areas of less than 10 acres, with slopes no greater than 5 %. Use of natural topographic lows is encouraged and natural drainage courses should be regarded as significant local resources to be kept in use (Young et al., 1996).

Selection Criteria (NCTCOG, 1993)

- Comparable performance to wet basins
- Limited to treating a few acres
- Availability of water during dry periods to maintain vegetation
- Sufficient available land area

Research in the Austin area indicates that vegetated controls are effective at removing pollutants even when dormant. Therefore, irrigation is not required to maintain growth during dry periods, but may be necessary only to prevent the vegetation from dying.

The topography of the site should permit the design of a channel with appropriate slope and cross-sectional area. Site topography may also dictate a need for additional structural controls. Recommendations for longitudinal slopes range between 2 and 6 percent. Flatter slopes can be used, if sufficient to provide adequate conveyance. Steep slopes increase flow velocity, decrease detention time, and may require energy dissipating and grade check. Steep slopes also can be managed using a series of check dams to terrace the swale and reduce the slope to within acceptable limits. The use of check dams with swales also promotes infiltration.

Additional Design Guidelines

Most of the design guidelines adopted for swale design specify a minimum hydraulic residence time of 9 minutes. This criterion is based on the results of a single study conducted in Seattle, Washington (Seattle Metro and Washington Department of Ecology, 1992), and is not well supported. Analysis of the data collected in that study indicates that pollutant removal at a residence time of 5 minutes was not significantly different, although there is more variability in that data. Therefore, additional research in the design criteria for swales is needed. Substantial pollutant removal has also been observed for vegetated controls designed solely for conveyance (Barrett et al, 1998); consequently, some flexibility in the design is warranted.

Many design guidelines recommend that grass be frequently mowed to maintain dense coverage near the ground surface. Recent research (Colwell et al., 2000) has shown mowing frequency or grass height has little or no effect on pollutant removal.

Summary of Design Recommendations

- 1) The swale should have a length that provides a minimum hydraulic residence time of at least 10 minutes. The maximum bottom width should not exceed 10 feet unless a dividing berm is provided. The depth of flow should not exceed 2/3rds the height of the grass at the peak of the water quality design storm intensity. The channel slope should not exceed 2.5%.
- 2) A design grass height of 6 inches is recommended.
- 3) Regardless of the recommended detention time, the swale should be not less than 100 feet in length.
- 4) The width of the swale should be determined using Manning's Equation, at the peak of the design storm, using a Manning's n of 0.25.
- 5) The swale can be sized as both a treatment facility for the design storm and as a conveyance system to pass the peak hydraulic flows of the 100-year storm if it is located "on-line." The side slopes should be no steeper than 3:1 (H:V).
- 6) Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible. If flow is to be introduced through curb cuts, place pavement slightly above the elevation of the vegetated areas. Curb cuts should be at least 12 inches wide to prevent clogging.
- 7) Swales must be vegetated in order to provide adequate treatment of runoff. It is important to maximize water contact with vegetation and the soil surface. For general purposes, select fine, close-growing, water-resistant grasses. If possible, divert runoff (other than necessary irrigation) during the period of vegetation

establishment. Where runoff diversion is not possible, cover graded and seeded areas with suitable erosion control materials.

Maintenance

The useful life of a vegetated swale system is directly proportional to its maintenance frequency. If properly designed and regularly maintained, vegetated swales can last indefinitely. The maintenance objectives for vegetated swale systems include keeping up the hydraulic and removal efficiency of the channel and maintaining a dense, healthy grass cover.

Maintenance activities should include periodic mowing (with grass never cut shorter than the design flow depth), weed control, watering during drought conditions, reseeding of bare areas, and clearing of debris and blockages. Cuttings should be removed from the channel and disposed in a local composting facility. Accumulated sediment should also be removed manually to avoid concentrated flows in the swale. The application of fertilizers and pesticides should be minimal.

Another aspect of a good maintenance plan is repairing damaged areas within a channel. For example, if the channel develops ruts or holes, it should be repaired utilizing a suitable soil that is properly tamped and seeded. The grass cover should be thick; if it is not, reseed as necessary. Any standing water removed during the maintenance operation must be disposed to a sanitary sewer at an approved discharge location. Residuals (e.g., silt, grass cuttings) must be disposed in accordance with local or State requirements. Maintenance of grassed swales mostly involves maintenance of the grass or wetland plant cover. Typical maintenance activities are summarized below:

- Inspect swales at least twice annually for erosion, damage to vegetation, and sediment and debris accumulation preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the swale is ready for winter. However, additional inspection after periods of heavy runoff is desirable. The swale should be checked for debris and litter, and areas of sediment accumulation.
- Grass height and mowing frequency may not have a large impact on pollutant removal. Consequently, mowing may only be necessary once or twice a year for safety or aesthetics or to suppress weeds and woody vegetation.
- Trash tends to accumulate in swale areas, particularly along highways. The need for litter removal is determined through periodic inspection, but litter should always be removed prior to mowing.
- Sediment accumulating near culverts and in channels should be removed when it builds up to 75 mm (3 in.) at any spot, or covers vegetation.
- Regularly inspect swales for pools of standing water. Swales can become a nuisance due to mosquito breeding in standing water if obstructions develop (e.g. debris accumulation, invasive vegetation) and/or if proper drainage slopes are not implemented and maintained.

Cost

Construction Cost

Little data is available to estimate the difference in cost between various swale designs. One study (SWRPC, 1991) estimated the construction cost of grassed channels at approximately \$0.25 per ft². This price does not include design costs or contingencies. Brown and Schueler (1997) estimate these costs at approximately 32 percent of construction costs for most stormwater management practices. For swales, however, these costs would probably be significantly higher since the construction costs are so low compared with other practices. A more realistic estimate would be a total cost of approximately \$0.50 per ft², which compares favorably with other stormwater management practices.

Table 2 Swale Cost Estimate (SEWRPC, 1991)

Component	Unit	Extent	Unit Cost			Total Cost		
			Low	Moderate	High	Low	Moderate	High
Mobilization / Demobilization-Light	Swale	1	\$107	\$274	\$441	\$107	\$274	\$441
Site Preparation	Acre	0.5						
Clearing ^b			\$2,200	\$3,800	\$5,400	\$1,100	\$1,900	\$2,700
Grubbing ^c			\$3,800	\$5,200	\$6,600	\$1,900	\$2,600	\$3,300
General			\$2,10	\$3,70	\$5,30	\$781	\$1,376	\$1,972
Excavation ^d			\$0,20	\$0,35	\$0,50	\$242	\$424	\$605
Level and Till ^e								
Sites Development								
Salvaged Topsoil	Yd ²	1,210						
Seed, and Mulch ^f			\$0,40	\$1,00	\$1,60	\$484	\$1,210	\$1,936
Sod ^g	Yd ²	1,210	\$1,20	\$2,40	\$3,60	\$1,452	\$2,904	\$4,356
Subtotal	--	--	--	--	--	\$5,116	\$9,388	\$13,660
Contingencies	Swale	1	25%	25%	25%	\$1,279	\$2,347	\$3,415
Total	--	--	--	--	--	\$6,395	\$11,735	\$17,075

Source: (SEWRPC, 1991)

Note: Mobilization/demobilization refers to the organization and planning involved in establishing a vegetative swale.

^a Swale has a bottom width of 1.0 foot, a top width of 10 feet with 1:3 side slopes, and a 1,000-foot length.^b Area cleared = (top width + 10 feet) x swale length.^c Area grubbed = (top width x swale length).^d Volume excavated = (0.67 x top width x swale depth) x swale length (parabolic cross-section).^e Area filled = (top width + 8(swale depth)² / 3(top width)) x swale length (parabolic cross-section).^f Area seeded = area cleared x 0.5.^g Area sodded = area cleared x 0.5.

Table 3 Estimated Maintenance Costs (SEWRPC, 1991)

Component	Unit Cost	Swale Size (Depth and Top Width)		Comment
		1.5 Foot Depth, One-Foot Bottom Width, 10-Foot Top Width	3-Foot Depth, 3-Foot Bottom Width, 21-Foot Top Width	
Lawn Mowing	\$0.85 / 1,000 ft ² / mowing	\$0.14 / linear foot	\$0.21 / linear foot	Lawn maintenance area = (top width + 10 feet) x length. Mow eight times per year
General Lawn Care	\$9.00 / 1,000 ft ² / year	\$0.18 / linear foot	\$0.28 / linear foot	Lawn maintenance area = (top width + 10 feet) x length
Swale Debris and Litter Removal	\$0.10 / linear foot / year	\$0.10 / linear foot	\$0.10 / linear foot	-
Grass Reseeding with Mulch and Fertilizer	\$0.30 / yd ²	\$0.01 / linear foot	\$0.01 / linear foot	Area revegetated equals 1% of lawn maintenance area per year
Program Administration and Swale Inspection	\$0.15 / linear foot / year, plus \$25 / inspection	\$0.15 / linear foot	\$0.15 / linear foot	Inspect four times per year
Total	--	\$0.58 / linear foot	\$0.75 / linear foot	-

Maintenance Cost

Caltrans (2002) estimated the expected annual maintenance cost for a swale with a tributary area of approximately 2 ha at approximately \$2,700. Since almost all maintenance consists of mowing, the cost is fundamentally a function of the mowing frequency. Unit costs developed by SEWRPC are shown in Table 3. In many cases vegetated channels would be used to convey runoff and would require periodic mowing as well, so there may be little additional cost for the water quality component. Since essentially all the activities are related to vegetation management, no special training is required for maintenance personnel.

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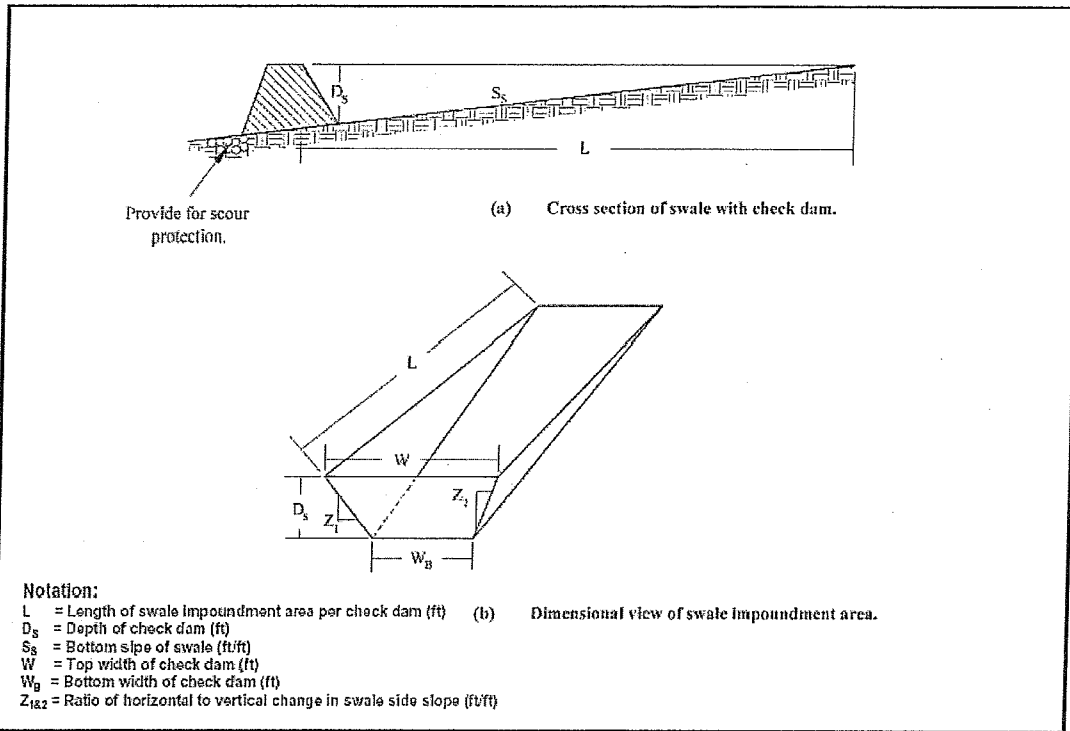
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Vegetated Swale

TC-30



ATTACHMENT F

**OPERATION AND MAINTENANCE PROGRAM FOR
TREATMENT BMPS**

Table A - Recommended BMP Schedule and Cost Estimate
(repeat each year in perpetuity)

Date	Procedure Code (from Table D)	Estimated Costs	
		Labor	Materials/Disposal
1-Oct	W1	\$50	\$10
	G1, G2	\$200	\$100
	D1	\$25	\$10
1-Jan	W1	\$50	\$10
	G1	\$100	\$0
	D1	\$25	\$10
1-Apr	W1, W2	\$100	\$10
	G1, G2	\$200	\$100
	D1, D2, D3	\$300	\$50
As needed (if discovered at inspection)	W3	\$50	\$50
	G3	\$50	\$50
	D1, D2, D3*		

\$1,150

\$400 Subtotals

* D1 shall be performed after *major* rainfall events in addition to the schedule shown. If necessary, immediate action of D2 and D3 may be required at any time.

**** Annual Estimate Total \$1,550**

** Estimate does not include costs that may be incurred for total replacement of major drainage features that may be required as part of the construction materials life cycle (i.e. a system re-build in 50 years or so)


Table B - BMP Inspection, Maintenance, and Replacement Procedures				
Definitions	(W) Waste and Spill Control	(G) Ground Cover	(D) Detention Basin	
code		G1	D1	
(1) Inspection	Inspect site, especially motor vehicle areas, for spills of petroleum products, solvents and other hazardous wastes. Visually inspect standard catch basins and clear debris. Consult CD guides as needed.	Inspect site for signs of failure of ground cover to thrive, washing out or erosion below material. Inspect irrigation system for signs of over or under watering.	Inspect the detention basin inlet device and clear or dispose of any caught debris. Measure distance from top of sediment to primary horizontal orifice. Check incoming and outgoing pipes and clear any debris.	
code		G2	D2	
(2) Maintenance (Service)	Perform inspection duties AND lift grates from catch basins and remove & clean debris from basins. See Caltrans Guide CB12 if hazardous material spills have occurred and follow procedures outlined therein.	If needed, restore slope to previous condition, determine nature of failure, replace or repair faulty irrigation system components.	Every procedure interval OR If the top of sediment is within 3" of the bottom of the horizontal orifice, clear and remove sediment down to the top of the filter fabric/channel inlet. Brush-clean filter fabric.	
code		G3	D3	
(3) Replacement (Media Change)	Replace catch basin grates if damaged.	Re-plant material if existing material is unrecoverable. Cover slopes if during rainy season with slope protection medium while plant material is maturing.	Perform all 'Inspection' and 'Service' duties above AND remove filter fabric and inspect gravel and perforated pipe for sediment or failure. Replace fabric and perf pipe and gravel if necessary.	

** Refer to attached specifications for further information

ATTACHMENT H

CERTIFICATION SHEET

This Stormwater Management Plan has been prepared under the direction of the following Registered Civil Engineer. The Registered Civil Engineer attests to the technical information contained herein and the engineering data upon which recommendations, conclusions, and decisions are based.

A handwritten signature in black ink, appearing to read "Curtis H. [unclear]", is written over a horizontal line.

2-24-10

Date